# Space Weather Technical Forecast

Issued on Wednesday, 24 November 2021 at 00:56 Local

**This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

**Space Weather Forecast Headline: No significant activity**

**Analysis of Space Weather Activity over past 24 hours**

**Solar Activity:** Solar activity was very low, with no significant flares detected. There are currently three numbered and one un-numbered sunspot regions in view, with AR2896 and AR2897 in the west both small and simple uni-polar spots, with Axx/Alpha configurations. AR2898 (Beta/Bxi) emerged early in the period in the southeast, and a further as yet un-numbered region (Bxo/Beta) emerged in the southeast near the meridian later in the period. A weak CME was evident in coronagraph imagery departing in the southwest around 23/1230 UTC, this will be analysed if further imagery becomes available, otherwise no Earth-directed CMEs were evident.

**Solar Wind / Geomagnetic Activity:** Solar wind speeds, as measured by DSCOVR at L1, were elevated for much of the period, reaching 560 km/s at 23/1343 UTC, before erratically declining and ending slightly elevated near 490 km/s. Density values were slightly above average at times 23/0400-1100 UTC. Total IMF Bt was weak at 2-6 nT, with an unremarkable north-south component Bz of +/-5 nT. Phi angle remained in a negative (toward sun) orientation. Resultant geomagnetic activity was Quiet (Kp1-2).

**Energetic Particles / Solar Radiation:** The high energy proton flux (greater than 10 MeV) remained at background, with no solar radiation storms detected. The high energy electron flux (greater than 2 MeV) was at predominantly moderate levels, but briefly reached high levels through the diurnal cycle, with 1090 pfu recorded at 23/1745 UTC. Associated 24-hour integrated fluence remained below the Active threshold (1e8 integrated pfu), but with an increasing trend, and with 4.08e7 integrated pfu recorded at 24/0000 UTC.

**Four-Day Space Weather Forecast Summary**

**Solar Activity:** With only small and simple sunspots expected in view, solar activity is expected to remain very low, with just a slight chance of C-class flares.

**Solar Wind / Geomagnetic Activity:** No Earth-directed CMEs are currently forecast. Solar winds are expected return to background values by day 2 (25th) under waning high speed stream influences, with mostly Quiet geomagnetic activity. However, further enhancements are possible by day 3 (26th) under coronal hole influences, bringing occasional Unsettled intervals, and a slight chance of Active intervals, but this is low confidence.

**Energetic Particles / Solar Radiation:** The high energy (greater than 10 MeV) proton flux is expected to remain at background levels. The high energy electron flux (greater than 2 MeV) is expected to reach moderate to high levels through the diurnal cycle, with just a slight chance of associated 24-hour integrated fluence rising above the active threshold.

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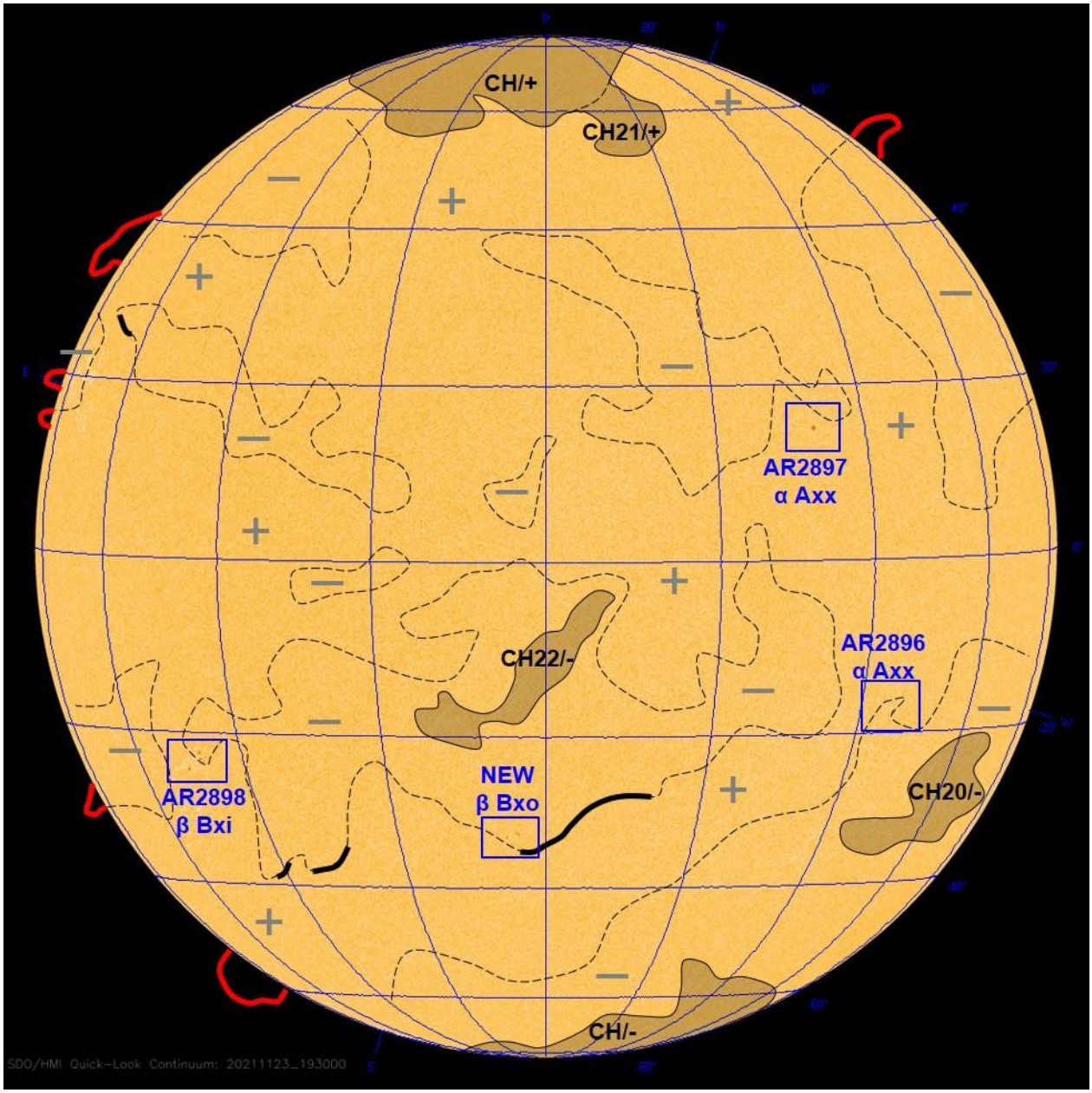
**Figure 1. Solar Analysis Valid 23/2000 UTC**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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## Geomagnetic Storms:

There are currently no Earth-directed CMEs forecast.

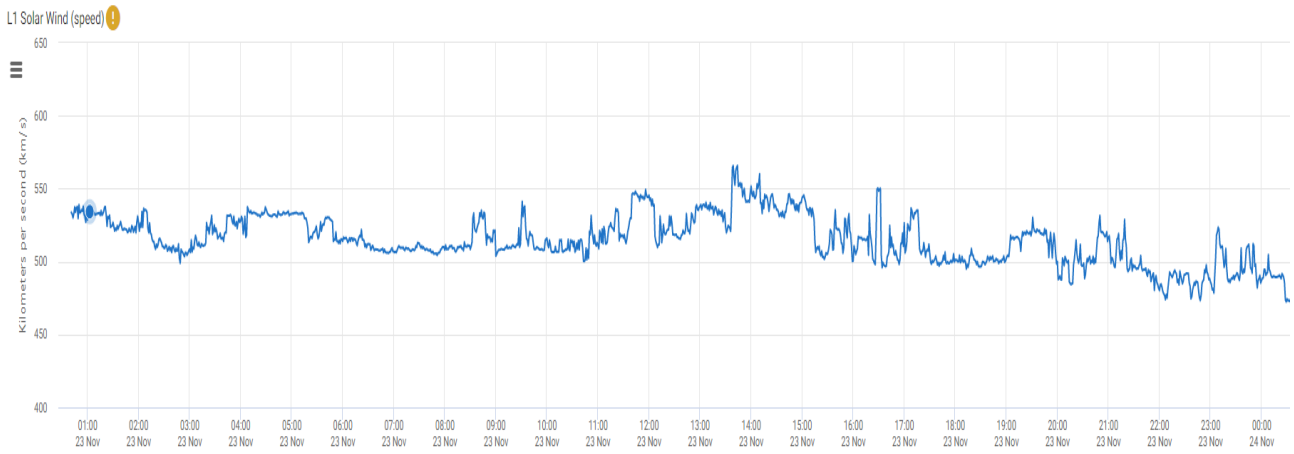
Solar wind speeds should slowly return to background levels by day 2 (25th) as the fast wind from CH20 towards the southwest limb wanes. Any further enhancements to the solar wind are then low confidence for the rest of the period, with possible weak influences from CH21, an extension of the northern polar crown by day 3 (26th). Earth may then connect with a high speed stream from negative CH22, just south of the equator, by day 4. STEREO A data showed some increasingly disturbed solar wind parameters on 23rd, which might be expected three days later at Earth, on 26th. However, this included a switch to a positive sector of the sun's surface, making CH22 effects unlikely, and with no significant increase in solar wind speeds.
Mostly Quiet geomagnetic activity expected to start, with an increased chance of Unsettled intervals and a slight chance of Active intervals by day 3 (26th).

| Geo-Magnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 1 | 2 | 5 | 5 |
| Strong | G3 | No | 1 | 1 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

## Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

**Figure 2: Past 24 hours solar wind speeds at L1, showing an erratic decreasing trend from 23/1400 UTC.**

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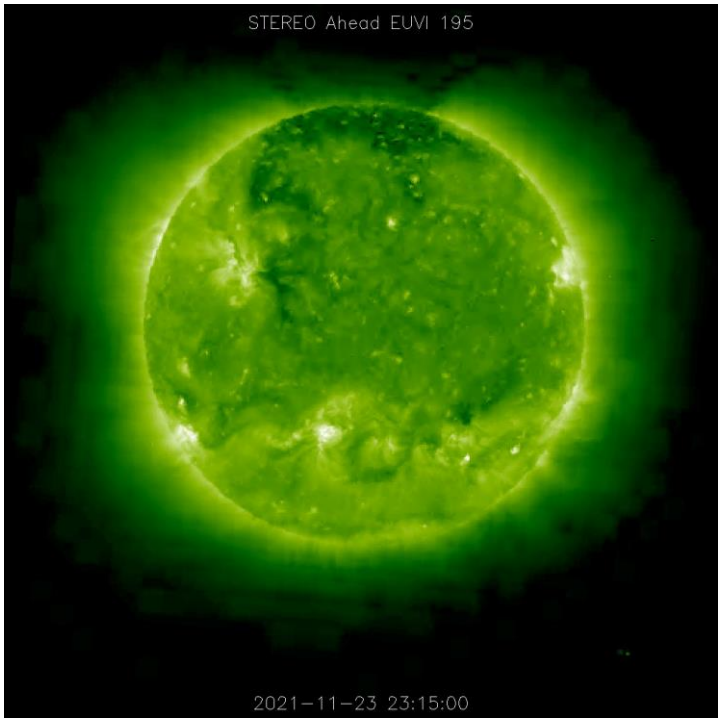
## Radio Blackouts - X-Ray Flares:

Solar activity is currently very low, and expected to remain at these levels, with no significant flares expected from the current four small and magnetically simple sunspot regions on the visible disc. However, the two Beta sunspots in the east will be monitored for any significant increases in complexity. A further bright flux region evident in STEREO EUVI imagery may indicate a further active region, this may have been the source of a CME early on 23rd, and likely to move into view over the southeast horizon on day 2 (25th).

| X Ray Flares | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability | | | (%) | (%) | (%) | (%) |
| Active | R1-R2 M Class | No | 1 | 1 | 1 | 1 |
| Very Active | R3 to R5 X Class | No | 1 | 1 | 1 | 1 |

**Figure 3: STEREO A image, showing potential sunspot region around 100 deg E in the far SE.**

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## Solar Radiation Storms - (High Energy Protons):

In the absence of any significant flare activity, the high energy proton flux (greater than 10 MeV) is forecast to remain at background levels, with no solar radiation storms expected.

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Active | ≥ S1 | No | 1 | 1 | 1 | 1 |
| Very Active | ≥ S3 * | No | 1 | 1 | 1 | 1 |
| * S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$) | | | | | | |

## High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2 MeV) as measured by GOES-16 at GEO briefly reached high levels through the diurnal cycle on 23rd, and its slowly increasing trend is likely to continue as any compression of the Van Allen belts reduces as the current fast wind of CH20/- slowly wanes through day 1 (24th). Flux levels may drop again later in the period under further coronal hole influences, but this is low confidence at this stage.
Corresponding electron fluence is expected to continue to see an increasing trend into day 2 (25th) but with just a slight chance of rising above the active threshold (1e8 integrated pfu). Confidence is low through the rest of the period, values may reduce again due to a slight increase in geomagnetic activity. MOSWOC REFM data is giving reasonable guidance to start the period, but the current reset to higher values on 25th is unrealistic.

| GEO Electron Environment Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Active | ≥ 2 MeV ≥ $1x10^8$ | No | 10 | 20 | 10 | 10 |
| Very Active | ≥ 2 MeV ≥ $1x10^9$ | No | 1 | 1 | 1 | 1 |

**Figure 4: Latest MOSWOC REFM data, showing unrealistic jump in values on 25th.**

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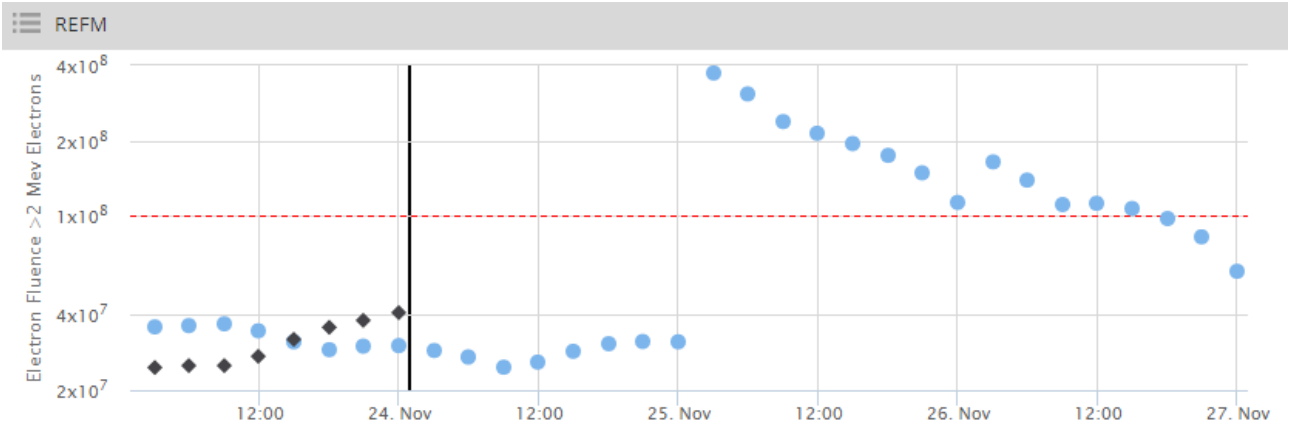


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